WEATHERPAK® -400

User Manual

Revision 7 (V7)
October 28, 2002

COASTAL ENVIRONMENTAL SYSTEMS

820 First Avenue South • Seattle, WA 98134
(206) 682-6048 (800) 488-8291 Fax: (206) 682-5658

www.CoastalEnvironmental.com

LIST OF FIGURES 1

IMPORTANT NOTES 2

1.0 INTRODUCTION 3

2.0 INSTALLATION 4
- 2.1 Siting Considerations 4
- 2.2 Tower Mount 5
- 2.3 Van Mount 7
- 2.4 Receiver Box Connections 9
- 2.5 Connection to a Computer 10

3.0 OPERATION 11
- 3.1 Receiver Box Display Interpretation 11
- 3.2 Using the Computer with Plume Modeling Software 12
- 3.3 Data Line Interpretation 14

4.0 MAINTENANCE 15
- 4.1 Periodic Maintenance Schedule 15
- 4.2 Troubleshooting 15
- 4.3 Replacing Tower Batteries and Fuse 17

EQUIVALENT WIND CHILL TEMPERATURES 18

HEAT STRESS INDEX 19

LIST OF FIGURES

1. Placement of the WEATHERPAK ® on top of vehicles 4

2. The WEATHERPAK ®-400TRX with Tower 5

3. Tower Mount Set Up 6

4. The WEATHERPAK® -400VM (Van Mount) 7

5. Van Mount Quick Release 8

6. Receiver Box Rear Panel Connections 9

7. Computer with Receiver 10

8. Receiver Front Panel 11

9. ALOHA screen capture 13

10. ALOHA map 13

11. Replacing the batteries 17

12. Replacing the batteries (2) 17

IMPORTANT NOTES

DO CALL/FAX US IF YOU HAVE QUESTIONS OR PROBLEMS
Call Coastal Environmental Systems if any troubles arise or if you have any questions pertaining to the equipment. Our telephone number is 206-682-6048 and the FAX number is 206-682-5658. Refer to the model number (WEATHERPAK® -400) and the serial number of the WEATHERPAK®.

DO WASH OFF CHEMICALS OR DEBRIS WHILE THE WEATHERPAK® IS ASSEMBLED to prevent getting water in the connectors. The WEATHERPAK® is water-resistant when assembled.

DO FOLLOW THE MAINTENANCE SCHEDULE. (See the periodic maintenance schedule in Section 4.1)

INCORRECT WIND SPEED WILL RESULT IF THE PROPELLER NUT IS NOT TIGHT.

DO NOT OPEN THE WEATHERPAK®. It is purged with desiccant bags to seal out all the moisture. Opening it may allow moisture to foul the electronics and will invalidate the warranty.

DO NOT PICK UP THE WEATHERPAK® BY THE WIND VANE. This is a durable but sensitive wind sensor and it can be broken if it is used to lift the entire unit.

DO NOT REMOVE THE ANTENNA FROM THE WEATHERPAK®. If the WEATHERPAK® is activated without the antenna, the radio can be damaged.

1.0 INTRODUCTION

A WEATHERPAK® -400 measures the air temperature and the speed, direction and stability class of the wind. As an option, it can measure barometric pressure and relative humidity. Information is sampled every 2 seconds and then computed into a 5-minute running average. The data is then transmitted to you every 30 seconds for an updated line of data.

A WEATHERPAK® -400 is suitable for extremely portable use when mounted on a van or a portable tower. It can also be mounted at a fixed site, such as an industrial plant.

The WEATHERPAK® was designed with the following unique features for use in hazardous materials response:

- A built-in electronic compass allows the WEATHERPAK® to be set up in any orientation – it will automatically determine true North and give you true wind direction. [1]
- Set-up time is under two minutes.
- When the unit is assembled, there are no electrical connections that can spark.
- The housing is constructed of 6061-T6 aluminum that is non-corrosive and will not spark if dropped or struck.
- The housing is sealed and dried with desiccant to protect the electronics against moisture. This means that the WEATHERPAK® can easily withstand decontamination procedures.
- A beeper in the tower sounds when battery replacement is required because of low voltage in the battery pack. [2]
- All of the electronics are grounded at a single point to protect the WEATHERPAK® against unexpected large voltages and radio interference.

This manual will familiarize you with the installation, operation and maintenance of a WEATHERPAK® -400. Please read all of the instructions before attempting to operate or troubleshoot the WEATHERPAK®.

[1] The variation of true North from magnetic North is entered into your WEATHERPAK® for your location. It is easily changed, but should not be done so without first consulting Coastal Environmental Systems. (requires test cable)

[2] The WEATHERPAK® must be installed for the beeper to function.

2.0 INSTALLATION

2.1 Siting Considerations

a) Compass Measurements – Remember that the WEATHERPAK® contains a compass for automatic North alignment. Like any compass, it can make an error if located too close **(laterally)** to large amounts of steel or other magnetic material. (In other words, on top of a van is OK, but next to it is not an ideal location.) Try to place the WEATHERPAK® at least 30 meters from large vans, busses, cranes, etc.

b) Wind Measurements – Select as exposed a site as is possible. The wind pattern around a building or other obstacle is disturbed for a considerable distance. If the WEATHERPAK® is placed immediately North of your vehicle and the wind is coming from the South, an erroneous wind direction and speed reading will result.

c) Radio Transmissions – Locate the WEATHERPAK® as close as safety permits within 2 miles of the receiving unit. Do not attempt to transmit through structures containing steel, or through hills. [3]

Figure 1. Placement on top of vehicles is okay

[3] Ideal conditions. Reception range will vary depending on radio signal path.

2.2 Tower Mount

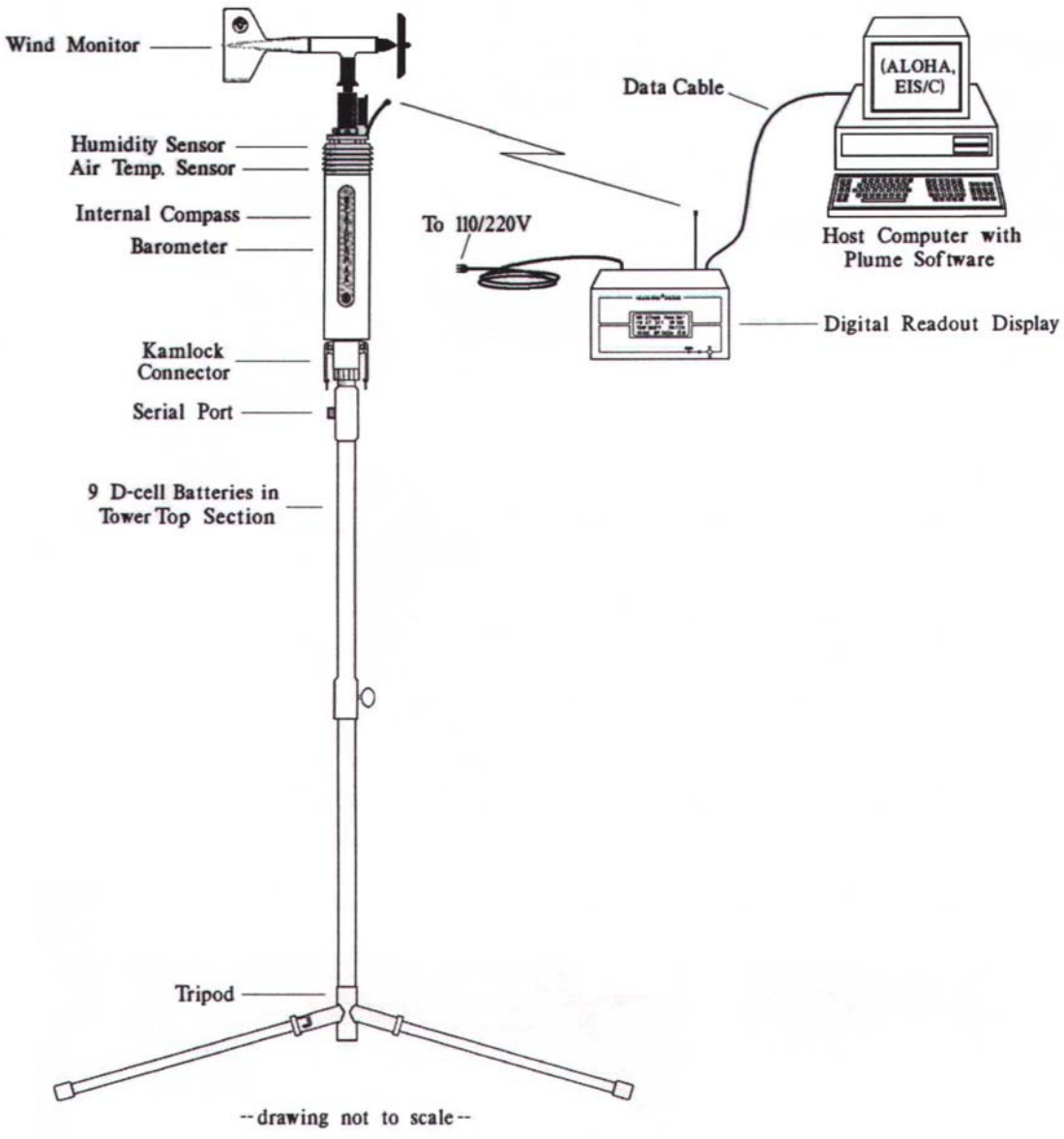
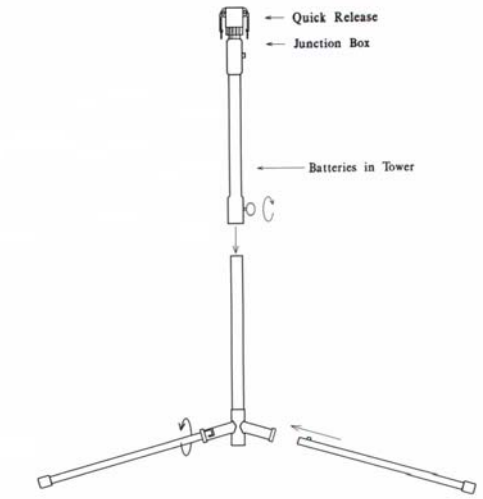


Figure 2. The WEATHERPAK® –400TRx with tower

TOWER MOUNT SETUP

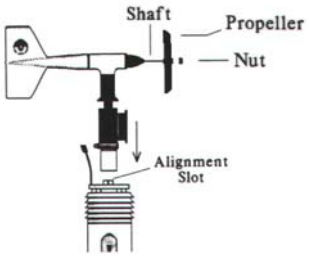
1) Lock the legs on to the bottom section of the tower forming the tower tripod base.



2) Remove the wind vane from the case. Place the propeller on the front shaft screw the nut into place on the propeller shaft to secure the propeller.

3) Plug the wind vane into the top of the WEATHERPAK®. There is an alignment pin and slot inside the connector to assure a proper and aligned fit.
Be certain that the wind vane is plugged all the way in.
DO NOT rotate the wind vane when installing or removing.

4) Align the slot on the WEATHERPAK® with the guide pin on the quick release and push straight in. (DO NOT "screw" the WEATHERPAK® onto the quick release.) This is a good sealed fit and may require an extra push - then **push the arms of the clamp down** to assure a tight fit.
DO NOT rotate the WEATHERPAK® or tower when installing or removing.



5) Place the entire unit -- tower top and WEATHERPAK® – onto the tripod and securely tighten the tower locking knob.

6) The WEATHERPAK® is now running and is sampling. When the WEATHERPAK® is removed from the Quick Release, it will stop sampling and shut itself off.

2.3 Van Mount

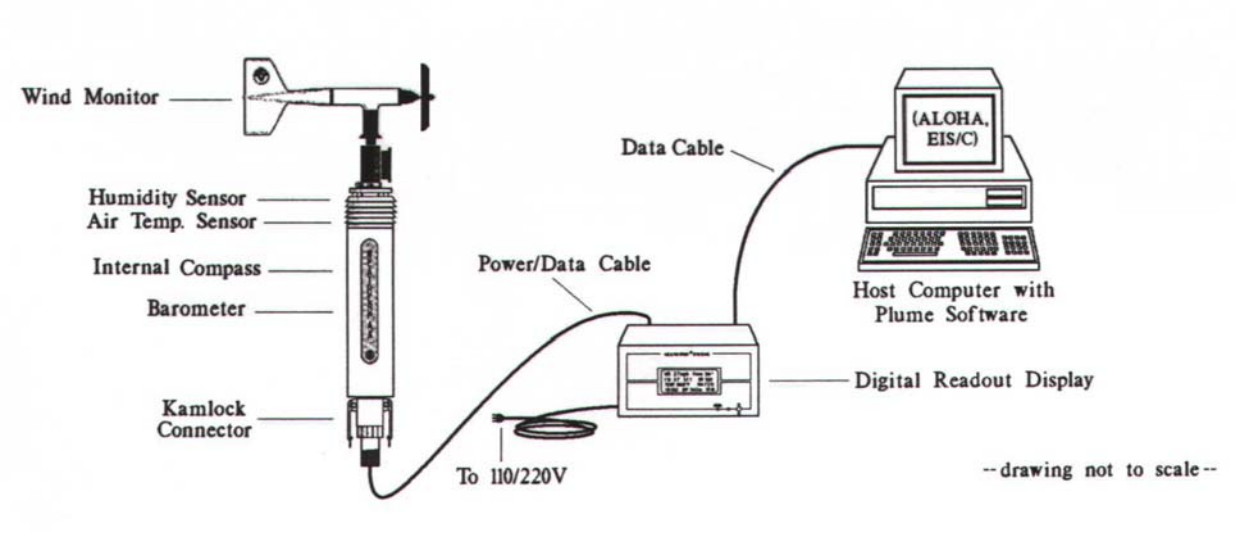


Figure 4. The WEATHERPAK® –400VM (Van Mount)

VAN MOUNT SETUP

1) Remove the wind vane from the case. Place the propeller on the front shaft screw the nut into place on the propeller shaft to secure the propeller.

2) Plug the wind vane into the top of the WEATHERPAK®. There is an alignment pin and slot inside the connector to assure a proper and aligned fit. **Be certain that the wind vane is plugged all the way in. DO NOT rotate the wind vane when installing or removing.**

3) Align the slot on the WEATHERPAK® with the guide pin on the quick release and push straight in. (DO NOT "screw" the WEATHERPAK® onto the quick release.) This is a good sealed fit and may require an extra push - then **push the arms of the clamp down** to assure a tight fit. DO NOT rotate the WEATHERPAK® or tower when installing or removing. Also, a series of about 5 beeps, should be heard. (portable tower only)

4) The WEATHERPAK® is now running and is sampling. When the WEATHERPAK® is removed from the Quick Release, it will stop sampling and shut itself off.

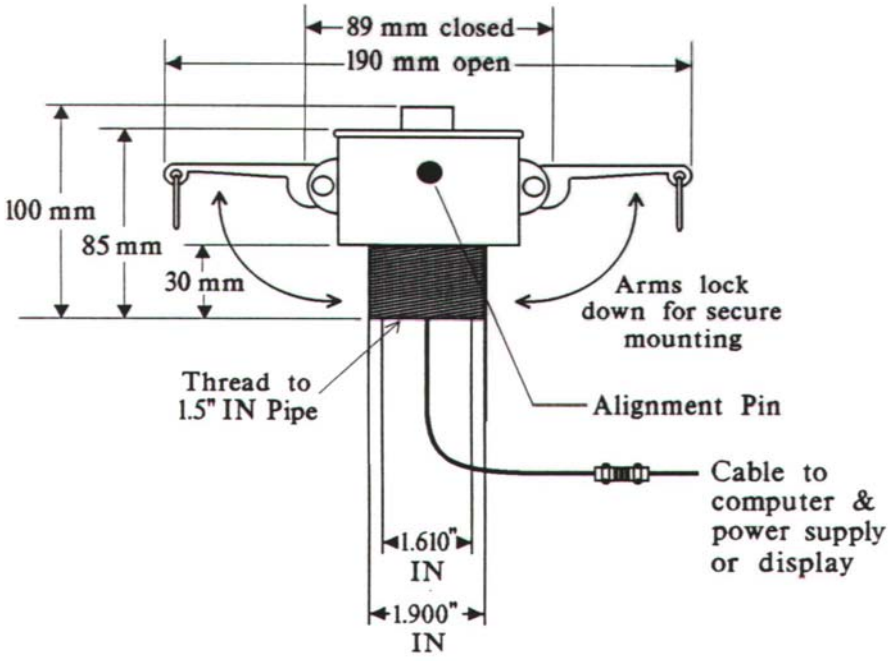


Figure 5. Van Mount Quick Release

The Van Mount Quick Release is permanently mounted on a vehicle. **Because of the variability of vehicles, the lower part of this bracket is assumed to be customer furnished. Coastal supplies the above with 1-½" female SPT.**

2.4 Receiver box connections

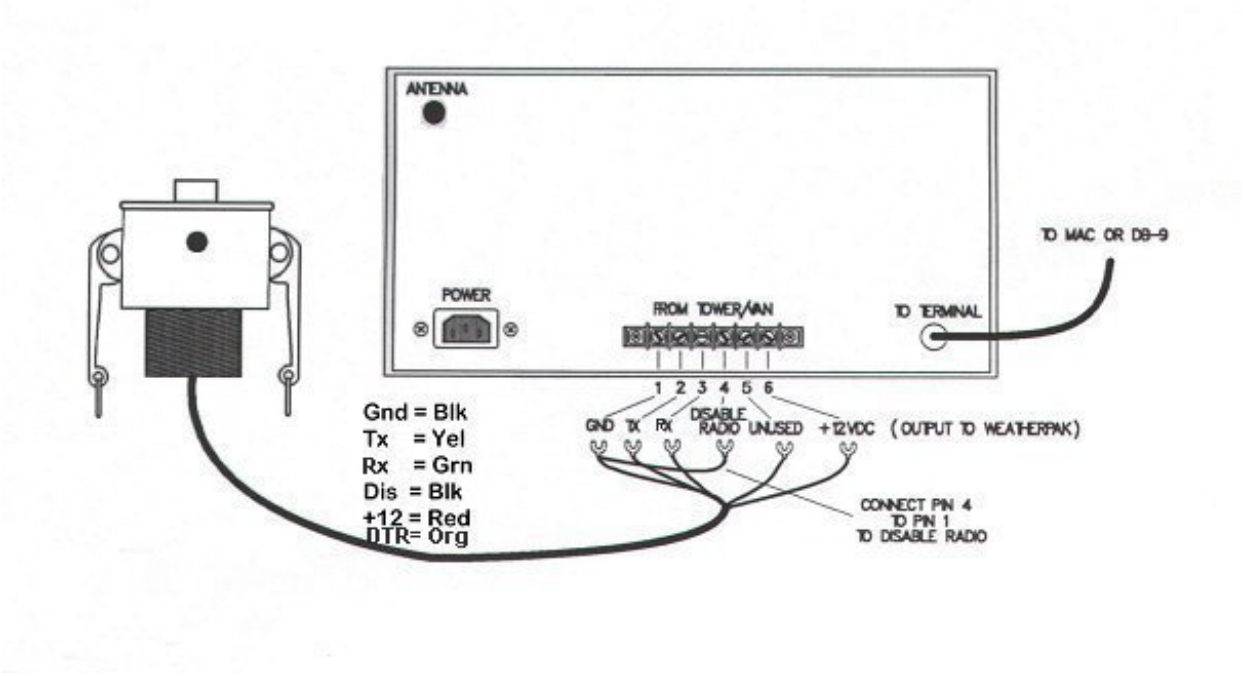


Figure 6. Receiver box rear panel connections.

INTERNAL SWITCHES

The following internal switches change the functions of the RX Box Display only. [4]

NOTE: DO NOT open the receiver/display box without permission from Coastal Environmental Systems' Customer Service, as doing so may void your warranty.

Always disconnect the A/C power cord before opening the box. The receiver box contains many static sensitive parts which can be inadvertently damaged by improper handling.

DS1 Unused (remains off)
DS2 Standard = off / Metric = on
DS3 Degrees = off / Ordinal points = on
DS4 Unused (remains off)
DS5 English = off / French = on

[4]The serial data will not be affected by switch settings.

2.5 Connection to a computer

a) Plug the receiver box power cord into a power source. (110V unless otherwise marked)
b) Plug one end of the serial data cable into the computer free COM port.
c) Turn the receiver switch on.
d) The receiver power indicator light should now be on.
e) If the WEATHERPAK® is set up and running, the carrier detect light on the receiver should blink briefly every 30 seconds as data is received. If the light doesn't blink, see the section on troubleshooting.

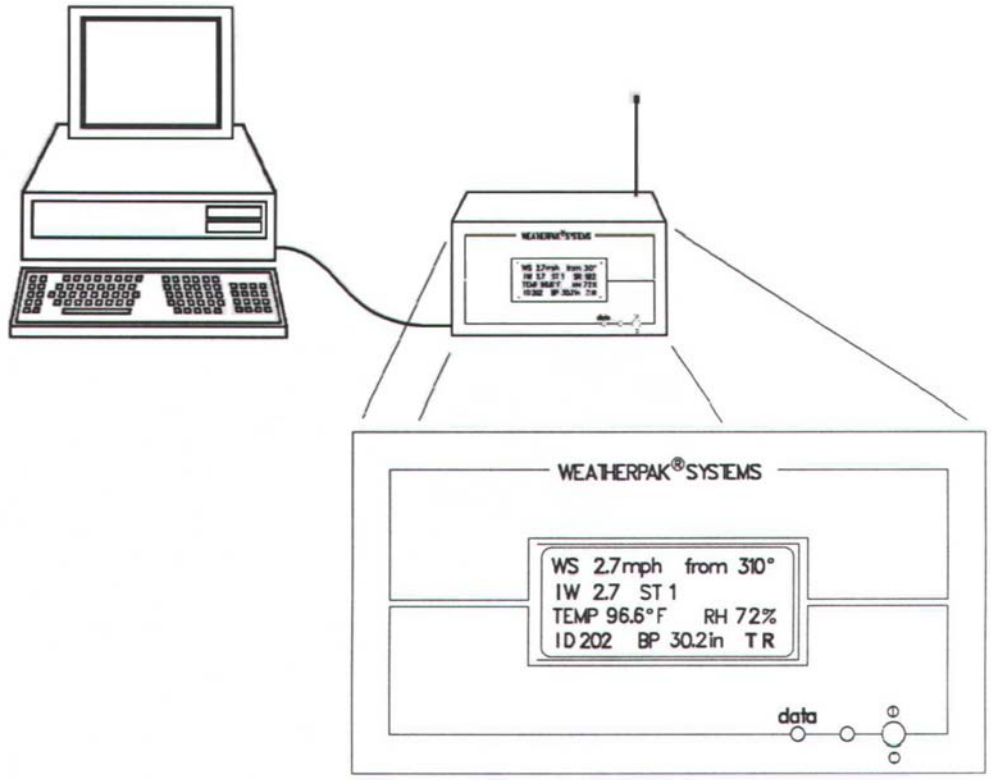
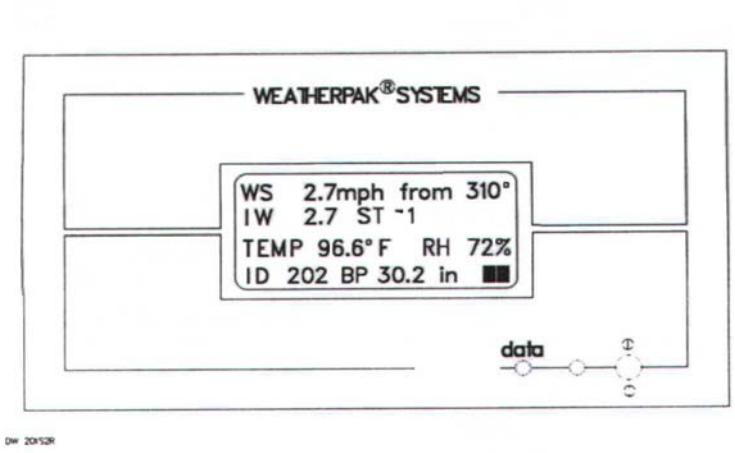


Figure 7. Computer with receiver, Display option shown

3.0 OPERATION

Once the WEATHERPAK® is set up, it turns itself on, starts sampling and transmits data every 30 seconds.[5] You can view the data on the receiver box, or you can view and manipulate the data on the computer using the ALOHA plume model software.

3.1 Receiver box display interpretation



EXAMPLE
Figure 8. Receiver front panel

The example is interpreted as follows: The five minute average wind **(WS)** is 2.7 miles per hour and is coming from 310 degrees. The instantaneous – one second wind speed **(IW)** is 2.7 miles per hour. The stability **(ST)** will range from –1 to 100. The –1 is a default reading for the first 5 minutes. After that it will range from 1 to 100. The higher the ST number, the more unstable the wind is with a corresponding wider area of concern. The air temperature **(TEMP)** is 96.6 degrees Fahrenheit. The relative humidity **(RH)** is an option. The **ID#** is unique to your WEATHERPAK®and will allow you to identify your WEATHERPAK® should you respond to a spill where there are several WEATHERPAKs®. The barometric pressure **(BP)** in inches is also an option.

LOW POWER INDICATORS

There are low power warning indicators which will flash in the lower right corner of the display. A **flashing "R"** indicates that the Receiver batteries are low.

R warning flash starts ≅ 11.5 VDC
Receiver lights go out ≅ 10.5 VDC

If the receiver lights go out, plug the receiver into a wall outlet, then reset the receiver by flipping the power switch off then back on. This will recharge the batteries.

Batteries last = 4 hours
Recharge time = 1 hour

A **flashing "T"** indicates that the batteries in the tower are low and need replacing. (See Section 4.3 for replacement instructions.)

[5] The rate is factory set. Contact Coastal Environment Systems if there is a need to change the sampling or transmission rates.

3.2 Using the computer with plume modeling software

With the WEATHERPAK set-up and operational and the Receiver/Display box connected to your computer, real-time data is available to run air dispersion plume modeling software.

IMPORTANT NOTE: Some versions of ALOHA (including 5.2.1) need to be upgraded in order to work with a Station for Atmospheric Measurement (SAM); the WEATHERPAK is a SAM. The US EPA provides CAMEO/ALOHA software downloads, support, and information at their website http://www.epa.gov/ceppo/cameo. These addresses change periodically – we'd appreciate knowing any changes you encounter.

The following is a brief outline on using the system to produce an ALOHA plume model on a PC operating Windows 95. There is a general assumption that the user is familiar with ALOHA and that the program is properly loaded on the user's computer. Please consult the ALOHA user's manual for additional details and program limitations.

1. Open ALOHA by clicking on its desktop icon, or selecting it from the Programs menu
2. A series of dialogue boxes will appear including important notes on program limitations.
3. A Text Summary window will appear with information summarizing the event.
4. Confirm that your Site Data information is correct. If required, use the SiteData pull-down menu to change it.
5. Using the pull-down menu SetUp/Chemical select the chemical (chlorine, for example).
6. Using the pull-down menu SetUp/Atmospheric/SAM Station a series of dialogue boxes will appear requiring user observations or assumptions. Relative humidity data is not captured automatically and can be hand-entered using data from the Receiver/Display box.
7. Using the pull-down menu SAMOptions select Processed Data. The WEATHERPAK delivers data in the proper format for ALOHA to use. A Processed SAM Data window will appear. If the WEATHERPAK has been collecting data for less than five minutes a warning message will be displayed in both the Text Summary and Processed SAM Data windows.
8. Before allowing selection of the source of the leak (tank, pipe, direct etc.), ALOHA requires the SAM station to record five minutes worth of data. Using the pull-down menu SetUp/Source select the source of the leak (tank, for example); a series of dialogue boxes will appear requiring user observations or assumptions.
9. Use the Display/Footprint pull-down menu to show the plume footprint. A footprint is required before plotting the plume onto a street map. Refer to the ALOHA manual for interpretations and explanations on selecting locations within the plume footprint.
10. Optional graphs: Use the Display pull-down menu to produce graphs for source strength release rate, concentration, and dose.
11. Use the Display/Tile Windows to show multiple windows on the same screen; reposition and re-size as needed. Display/Stack will organize and stack the windows for quick access.
12. To plot the plume onto a street map, use the Sharing pull-down menu. As weather conditions change the plume size and position will change shortly after the WEATHERPAK provides updated data. Note: some software versions require that the ALOHA window overlay the map window in order for the map-plume to update automatically.

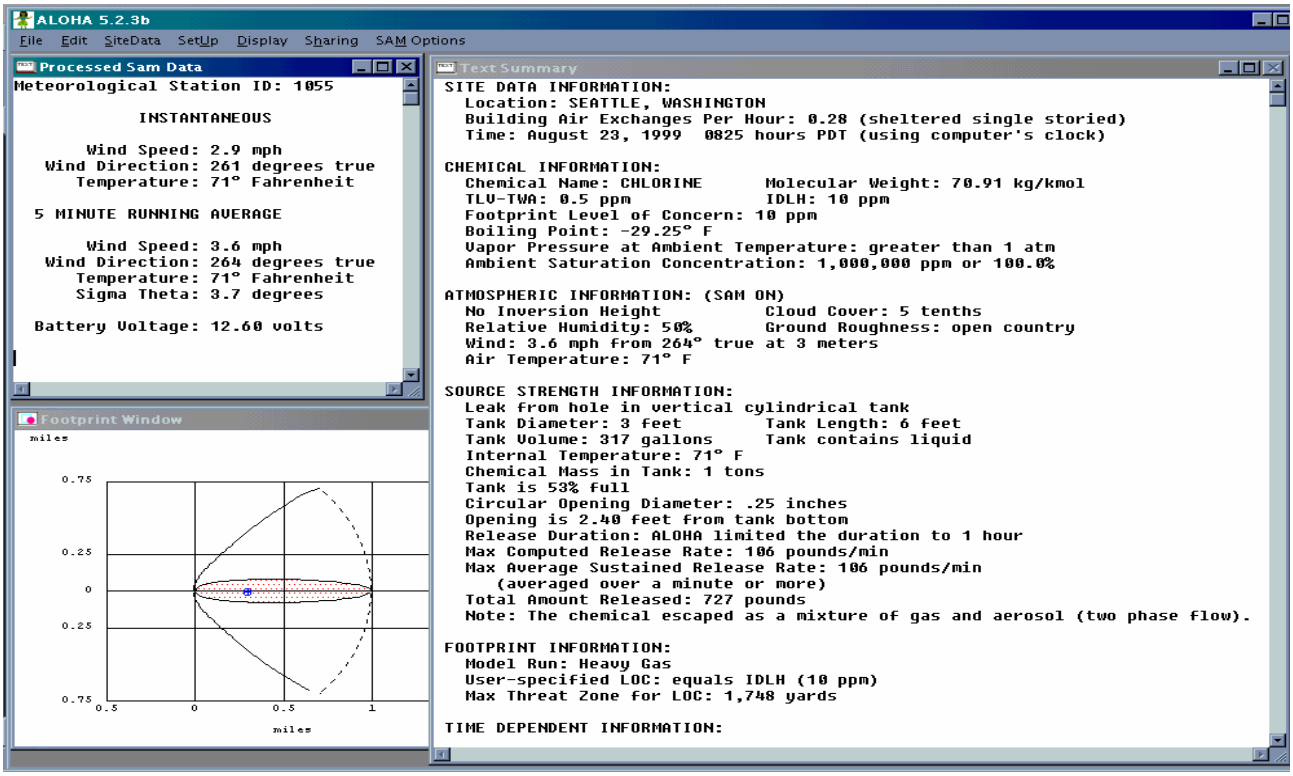

ALOHA 5.2.3b
File Edit SiteData SetUp Display Sharing SAM Options
Processed Sam Data
Meteorological Station ID: 1055
INSTANTANEOUS
Wind Speed: 2.9 mph
Wind Direction: 261 degrees true
Temperature: 71° Fahrenheit
5 MINUTE RUNNING AVERAGE
Wind Speed: 3.6 mph
Wind Direction: 264 degrees true
Temperature: 71° Fahrenheit
Sigma Theta: 3.7 degrees
Battery Voltage: 12.60 volts
Footprint Window
miles
Text Summary
SITE DATA INFORMATION:
Location: SEATTLE, WASHINGTON
Building Air Exchanges Per Hour: 0.28 (sheltered single storied)
Time: August 23, 1999 0825 hours PDT (using computer's clock)
CHEMICAL INFORMATION:
Chemical Name: CHLORINE Molecular Weight: 70.91 kg/kmol
TLV-TWA: 0.5 ppm IDLH: 10 ppm
Footprint Level of Concern: 10 ppm
Boiling Point: -29.25° F
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%
ATMOSPHERIC INFORMATION: (SAM ON)
No Inversion Height Cloud Cover: 5 tenths
Relative Humidity: 50% Ground Roughness: open country
Wind: 3.6 mph from 264° true at 3 meters
Air Temperature: 71° F
SOURCE STRENGTH INFORMATION:
Leak from hole in vertical cylindrical tank
Tank Diameter: 3 feet Tank Length: 6 feet
Tank Volume: 317 gallons Tank contains liquid
Internal Temperature: 71° F
Chemical Mass in Tank: 1 tons
Tank is 53% full
Circular Opening Diameter: .25 inches
Opening is 2.40 feet from tank bottom
Release Duration: ALOHA limited the duration to 1 hour
Max Computed Release Rate: 106 pounds/min
Max Average Sustained Release Rate: 106 pounds/min
(averaged over a minute or more)
Total Amount Released: 727 pounds
Note: The chemical escaped as a mixture of gas and aerosol (two phase flow).
FOOTPRINT INFORMATION:
Model Run: Heavy Gas
User-specified LOC: equals IDLH (10 ppm)
Max Threat Zone for LOC: 1,748 yards
TIME DEPENDENT INFORMATION:

Figure 9. ALOHA screen capture

The WEATHERPAK takes a sensor sample approximately every 1-2 seconds and calculates a five minute running average and sends updated data approximately every thirty seconds. "INSTANTANEOUS" data is captured just prior to the thirty-second update. By comparing the "5 MINUTE RUNNING AVERAGE" and "INSTANTANEOUS" data, the user can get a good idea of changing conditions. The WEATHERPAK calculates "Sigma Theta", or air mixing, and produces a Stability Class value used by the plume model. The battery voltage is also transmitted. Note: If voltage is below 11.0 the batteries in the WEATHERPAK tower should be replaced.

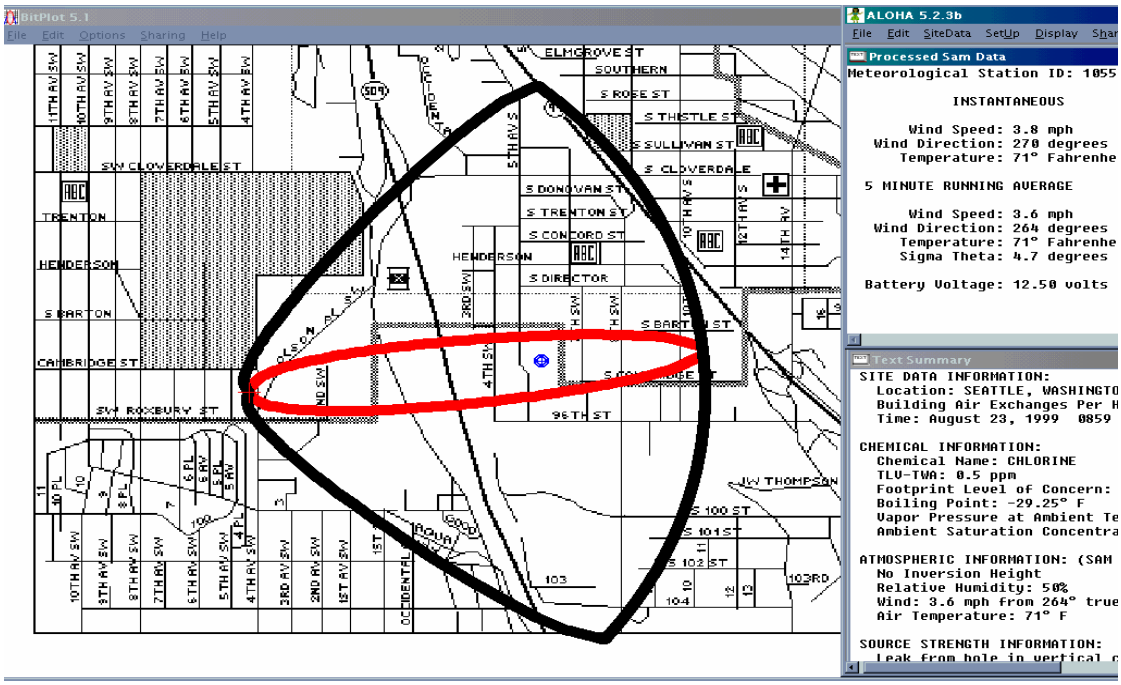


Figure 10. ALOHA map

If you pull down the "SAM Options" from the Main menu and select "Raw data", something like the following line of data will appear:

421, 0.9, 225, 1.0, 23.9, 1.0, 226, 23.9, 14.0, 1917, 999, 46, 2536

This is showing you exactly what the WEATHERPAK® is sending. Notice that most of these numbers are present in the "Processed Sam Data" on the previous page. The difference is that there are no labels and there are some additional numbers. Also, this raw data is in metric units (millibars, m/s, C), whereas the processed data is in standard English units (inches, m.p.h., F.)

The first number is the unique ID number (Serial #) of your WEATHERPAK®. If you do not have a WEATHERPAK® display screen, then this is how to identify your WEATHERPAK® if you respond to a spill where other WEATHERPAKs® are present. If you have a WEATHERPAK® display screen, the ID number appears on it.

Two "checksums" are performed to ensure that the message sent was correct. The computer adds up the "ASCII value" of the data line (each letter and number and comma, etc., has a numerical value universal to all computers) to make sure that the computer got the same number that the WEATHERPAK® transmitted.

3.3 Data line interpretation

The data line fields are as follows:

ID, MW, MD, ST, AT, SI, DI, TI, BV, CKSUM1, BP, RH CKSUM2

ID – WEATHERPAK® identification number
MW – 5 minute averaged wind speed in meters per second
MD – 5 minute averaged wind direction in degrees
ST – Stability class in degrees
AT – 5 minute averaged air temperature in degrees Centigrade
SI – Instantaneous wind speed in meters per second
DI – Instantaneous wind direction in degrees
TI – Instantaneous air temperature in degrees Centigrade
BV – Battery voltage in volts
CKSUM1 – First checksum
BP – Barometric pressure in millibars
RH – Relative humidity in percent
CKSUM2 – Second checksum

4.0 MAINTENANCE

4.1 Periodic maintenance schedule

Routine maintenance is required on the WEATHERPAK® every 12 months. This maintenance is to ensure that the overall system and its sensors are working and performing to specifications. The actual service varies, based on the sensors installed in your model of WEATHERPAK®. For example, a WEATHERPAK® –400 should have the wind, compass, air temperature (and, optionally, the barometric pressure and relative humidity) sensors tested to their stated specifications. In addition, the entire WEATHERPAK® should be examined for any wear, damage or other non-conforming variances.

4.2 Troubleshooting

Do not take the WEATHERPAK® or the Receiver box apart; this will void the warranty. If the procedures below do not solve the problem, call Coastal Environmental Systems.

4.2.1 The WEATHERPAK®

Is the WEATHERPAK® on?

Once the WEATHERPAK® is set up, it turns itself on, and starts sampling and transmits data every 30 seconds. If it does not:

Check that the WEATHERPAK® is properly secured in the quick release – reseat firmly.

- Check the power connection to the WEATHERPAK®, or
- Check the tower batteries and fuse.

4.2.2 The Receiver

Is the Receiver Box on?

The display light should be on and the display characters visible. If this does not occur, do the following:

- Be sure the receiver unit is plugged in and turned on. Check the power light on the front panel. It should be lit.
- If it is not lit, check for power at the outlet the RX Box is plugged into.
- Check the cable connections from the WEATHERPAK® to the receiver, they might be incorrectly wired. See section 2.4 figure 6.

Data light not flashing?

Every 30 seconds (approximately), the data light will flash signifying that the WEATHERPAK® is updating the display. If the light does not flash, then do the following:

- Be sure the receiver unit is plugged in and turned on. Check the power light on the front panel, it should be lit.
- Check to see if the WEATHERPAK® is “line of sight” (less than 2 miles, and not trying to transmit through hills, or steel walls, etc.)
- Be sure you are not trying to transmit through structures containing lots of steel.

- Check to see if both antennas are connected (WEATHERPAK® and receiver.)
- Unclamp, remove, wait 10 seconds, then replace the WEATHERPAK® on the tower (this resets it.)
- Check to see if the low battery beeper in the tower is beeping.
- Check that the batteries in the tower are properly aligned and are the correct voltage.
- Check the power connection to the WEATHERPAK®.
- Check the cable connections from the WEATHERPAK® to the receiver; they might be incorrectly wired.

4.2.3 Wind speed off?

- Check that the propeller is turning.
- There is a minimum threshold of about 2.5 –3 MPH.

Propeller is turning, wind speed reads zero?

- Make sure that the wind monitor has been pushed down all the way on to the WEATHERPAK®. See page 6, step 3 - Tower Mount Setup.

Wind direction off?

For this job you need a partner. Have your partner go to the wind monitor and hold the vane so the propeller points in a known direction. Does the display read correctly? If not:

- Make sure that the wind monitor has been pushed down all the way on to the WEATHERPAK®. There is an alignment pin and slot inside the connector to assure a proper and aligned fit; make sure that the pin is in the slot. See Step 3 and Step 4 of Tower Mount Setup.

Other sensor readings off?

Contact Coastal Environmental Systems. The WEATHERPAK® may be broken or require maintenance.

4.2.4 The Computer

There is data at the display but there is either no data or erroneous data at the computer.

- Check all the connections from the receiver to the computer.

Error messages while running plume modeling.

These are not related to the use of the WEATHERPAK®; these are coming from the plume modeling software.

- Consult your CAMEO/ALOHA manual.
- Contact the National Safety Council for help with the plume modeling software.
- Contact Coastal Environmental Systems as a last resort. We are not authorized CAMEO/ALOHA representatives; however, we may be able to help.

4.3 Replacing tower batteries and fuse

The WEATHERPAK® has nine alkaline D cell batteries which are located in the top section of the tower, as shown in the figure below. The batteries can be replaced with standard alkaline batteries. Make sure that the replacement batteries are of the same type.

There is an in-line fuse located in the tower junction box (see figure below.)

WEATHERPAK LOW BATTERY INDICATORS

1. A beeper will sound in the tower. The WEATHERPAK® must be installed. *Dead batteries will not activate the beeper.*
2. A "T" will flash on the Receiver front panel (see Sec. 3.1.)
3. The battery voltage reads below 11.0 on the "Processed Sam Data: screen (see Sec. 3.2.)

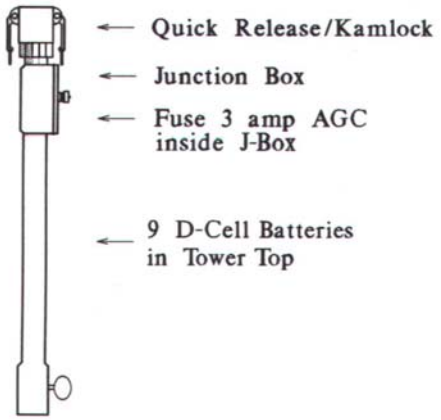


Figure 10. Replacing the batteries

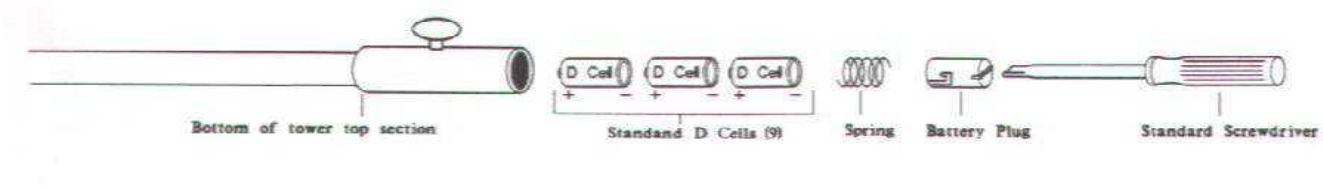


Figure 11. Replacing the batteries (2)

You will need a large screwdriver to replace the batteries. The battery "plug" is slotted. With the screwdriver, **PUSH** (the plug is held in place by a spring) and rotate the plug clockwise. The plug will come out followed by a spring and the batteries. Slide the new batteries in (positive end first) and replace the spring and plug.

To check the new voltage, set up the WEATHERPAK® and get the ALOHA plume model running. Then pull down the [MISC] menu to "Processed Sam data". One of the items shown is battery voltage (see figure 10 on page 14.) It should read about 13 to 15 volts. The tower low voltage beeper will go off when the battery voltage reaches 11 volts.

Equivalent Wind Chill Temperatures of Cold Environments

Actual Thermometer Reading, °F												
Wind Speed, mph	**50**	**40**	**30**	**20**	**10**	**0**	**-10**	**-20**	**-30**	**-40**	**-50**	**-60**
	Equivalent Chill Temperature, °F											
0	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	3	-9	-21	-34	-46	-58	-71	-83	-95
15	36	22	9	-5	-18	-32	-45	-59	-72	-86	-99	-113
20	32	18	4	-11	-25	-39	-53	-68	-82	-96	-110	-125
25	30	15	0	-15	-30	-44	-59	-74	-89	-104	-119	-134
30	28	13	-3	-18	-33	-48	-64	-79	-94	-110	-125	-140
35	27	11	-4	-20	-36	-51	-67	-83	-98	-114	-129	-145
40	26	10	-6	-22	-38	-53	-69	-85	-101	-117	-133	-148
***Little danger*: In less than 5 h, with dry skin. Maximum danger from false sense of security.**					***Increasing danger*: Danger of freezing exposed flesh within one minute.**			***Great danger*: Flesh may freeze within 30 seconds.**				

HEAT STRESS INDEX

TEMPERATURE °F	RELATIVE HUMIDITY								
	10%	20%	30%	40%	50%	60%	70%	80%	90%
104	98	104	110	120	132				
102	97	101	108	117	125				
100	95	99	105	110	120	132			
98	93	97	101	106	110	125			
96	91	95	98	104	108	120	128		
94	89	93	95	100	105	111	122		
92	87	90	92	96	100	106	115	122	
90	85	88	90	92	96	100	106	114	122
88	82	86	87	89	93	95	100	106	115
86	80	84	85	87	90	92	96	100	109
84	78	81	83	85	86	89	91	95	99
82	77	79	80	81	84	86	89	91	95
80	75	77	78	79	81	83	85	86	89
78	72	75	77	78	79	80	81	83	85
76	70	72	75	76	77	77	77	78	79
74	68	70	73	74	75	75	75	76	77

NOTE: Add 10°F when protective clothing is worn and add 10°F when in direct sunlight.

HUMITURE °F	DANGER CATEGORY	INJURY THREAT
BELOW 60°	NONE	LITTLE OR NO DANGER UNDER NORMAL CIRCUMSTANCE
80° - 90°	CAUTION	FATIGUE POSSIBLE IF EXPOSURE IS PROLONGED AND THERE IS PHYSICAL ACTIVITY
90° - 105°	EXTREME CAUTION	HEAT CRAMPS AND HEAT EXHAUSTION PROSSIBLE IF EXPOSURE IS PROLONGED AND THERE IS PHYSICAL ACTIVITY
105° - 130°	DANGER	HEAT CRAMPS OR EXHAUSTION LIKELY, HEAT STROKE POSSIBLE IF EXPOSURE IS PROLONGED AND THERE IS PHYSICAL ACTIVITY
ABOVE 130°	EXTREME DANGER	HEAT STROKE IMMINENT!